Waste milk, milk replacer or pasteurized waste milk

Which one of these makes the most sense for your dairy's calves?

By Bill Stone

At Issue: Quality milk replacers are expensive. To reduce that cost, dairies may opt to feed waste milk. But it can harbor pathogens such as *Salmonella* and *Mycoplasma* that can sicken calves today and result in future culls due to Johne's disease or bovine leukosis virus (BLV). On-farm milk pasteurizers can allow producers to use waste milk while reducing pathogen concerns and cutting milk replacer costs.

Research, testimonials, experiences

If your dairy doesn't have any contagious pathogens and your milk harvest and handling is highly hygienic, you can feed calves waste milk. But it's a risky practice: A pathogen-free or low prevalence herd today may not be tomorrow. The level of risk increases with herd size and the purchase of animals.

Pasteurizers can mitigate the risk of feeding waste milk. There are two types – batch pasteurizers and high-temperature short-time (HTST) units. Batch pasteurizers raise milk to a certain temperature, such as 145 degrees F, for a relatively long period of time – 30 minutes, for example. HTST units do what their name implies – they raise milk temperature to, for example, 161 degrees F and maintain it for a short time, such as 15 seconds.

The batch and smaller HTST units are self-contained, usually needing only a 240-volt service and one or two water lines to operate. The larger HTST units are equipped with a boiler to heat the water used in the pasteurization process.

Goodnature Products and Better Milk sell commercial HTST units. Dairy Tech, and to a limited extent Goodnature Products, sells batch pasteurizers.

How do batch pasteurizers and HTST units compare?

1. Batch pasteurizers are less expensive than HTST ones.

2. Only the amount of milk that will fit into the pasteurization tank can be processed in batch pasteurizers. With HTST units, milk is pasteurized as it flows through the system, so there isn't a maximum amount that can be pasteurized at one time.

HTST units differ primarily in the rate that milk can be pasteurized. Better Milk has units that pasteurize 45 to 90 gallons per hour (GPH), with 20- to 150-gallon pre-pasteurization holding tanks. Goodnature Products sells units that can pasteurize from 180 to 1,000 GPH.

3. With batch pasteurizers, large batches can take a long time to heatup, especially if the milk is chilled prior to pasteurization.

4. As batch size increases in a batch pasteurizer, it's important to verify that milk is being properly agitated and heated to the desired temperature for the desired time.

HTST units are usually designed to shunt milk back to the holding tank if it hasn't been adequately heated to ensure proper pasteurization.

Not sterilized

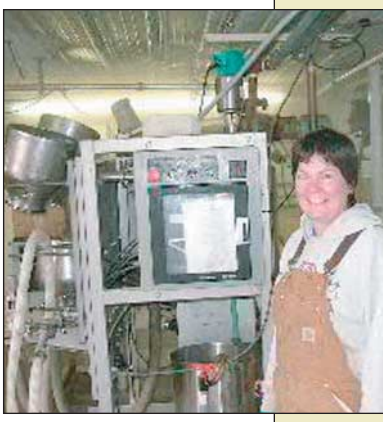
Pasteurizers kill pathogens that may be harmful to people. But do they kill pathogens that can infect a young calf? Yes. But pasteurization isn't the same as sterilization. Pasteurization significantly reduces pathogen counts, but it won't sterilize an overly contaminated batch of milk. Successful pasteurization begins with a relatively clean product.

In a lab, pasteurization killed all Johne's bacteria when samples were lightly and moderately infected but not when samples were heavily contaminated.

The effectiveness of pasteurization is a function of time and temperature. Different types of pathogens are susceptible at different time/temperature combinations.

If *Mycoplasma* and *Mycobacterium avium paratuberculosis (Map)*, which causes Johne's disease, are present at low or normal concentrations, batch pasteurization at 150 degrees F for 30 minutes and HTST pasteurization at 163 degrees F for 15 seconds should eliminate both pathogens. But pasteurization does not guarantee the destruction of *Map*, cautions Kathryn Boor, microbiologist with Cornell University's Food Science Department.

You would expect to see no or low milk concentrations of those two organisms in herds where udders are clean and animals don't have clinical signs of Johne's or *My-*



Penney Cook of Aurora Ridge Dairy, Aurora, N.Y., estimates that she spends 20 to 30 minutes a day with the dairy's HTST, CIP pasteurizer system.

FYI

- **Bill Stone is a veterinarian and a herd health and nutrition specialist with PRO-DAIRY.**
- **Pasteurizer suppliers include: Better Milk Inc., www.bettermilk.org. Tel: (877) 356-6455. Dairy Tech Inc., www.dairytech.org. (866) 384-2697. Goodnature Products Inc., www.goodnature.com. (800) 875-3381**

coplasma. The reverse is also true: Milking cows that have manure on their teats or with clinical Johne's disease or *Mycoplasma* mastitis can result in higher pathogen concentrations in the milk and increase the risk that some pathogens will survive pasteurization.

Neither type of pasteurizer is ideal for colostrum. It tends to morph into pudding with the HTST units. Colostrum can be pasteurized with a batch system, but antibody loss is significant. More than 58% of immunoglobulins were denatured when large batches (25 gallons) of colostrum were pasteurized, while the loss was reduced to 25 to 30% with a smaller batch (15 gallons). The researchers suggest that the greater loss of antibodies in the larger batch was probably the result of needing 2.5 to 3 hours to heat the volume of colostrum.

Colostrum with a 25% reduction in antibodies can provide a calf with adequate protection, providing the colostrum starts with a high level of immunoglobulins and the calf receives a gallon soon after birth.

Can milk be pasteurized too much? Yes, but it shouldn't be an issue with the time and temperature settings discussed here. Too much heat can damage the amino acids that form proteins, making some of them less available to calves.

Protein loss isn't significant until you actually see and smell differences in the milk, says Dave Barbano with Cornell's Food Science Department. Heat damaged milk develops a brown color and won't be as palatable to calves.

In a California study, calves fed pasteurized waste milk had a lower mortality rate and less pneumonia than calves fed raw waste milk. Producers I talked to were pleased with the health and growth rates of their calves fed pasteurized waste milk. That's no surprise. Whole milk is higher in fat (28-33%) than all milk replacers and higher in protein (24-26%) than most replacers.

Business/management mission & vision

Pasteurized milk is more likely to be contaminated with pathogens, including *Map*, than milk replacer. If your dairy's mission is to take every precaution to reduce the risk of infecting an animal with the Johne's bacterium, then you wouldn't feed pasteurized waste milk. But the risk is low if you follow sound milking and pasteurization practices.

Management requirement

A pasteurizer requires more management time – but not much – than mixing milk replacer.

It's important to dump "milk" that looks abnormal – is clear or has excessive clots or blood. Remember: Garbage going into a pasteurizer comes out as garbage.

Antibiotics in treated milk could disrupt the normal bacteria living in a calf's gastrointestinal system and cause scours. But this usually isn't an issue. Antibiotic contaminated milk could, however, result in antibiotic residues in calves. Remember this if you plan on marketing calves. To reduce antibiotic levels in treated milk, keep the treated quarter out of the calf milk supply. The long-term effect on microbial resistance from increased exposure to antibiotics isn't known.

Because pasteurization units are programmable, an operator doesn't need to be on hand during pasteurization. The larger HTST units have clean-in-place (CIP) systems. Smaller units and batch systems usually need to be washed by hand, requiring about 10 to 15 minutes. Penney Cook of Aurora Ridge Dairy, Aurora, N.Y., estimates that she spends only about 20 to 30 minutes a day with her HTST, CIP system.

Ideally, milk will be cooled to less than 40 degrees F, or immediately pasteurized following milking, then fed or cooled immediately following pasteurization. But some dairies are less stringent with their waste milk management and yet successful with their calves.

Cook typically runs the dairy's HTST pasteurizer twice in the morning. Calves are fed

Research papers on pasteurizers

1. Butler, J. A., et al. 2000. Pasteurization of discard *Mycoplasma* mastitic milk used to feed calves: thermal effects on various *Mycoplasma*. J. Dairy Sci. 83:2285-2288.

2. Godden, S. M., et al. 2003. Effect of on-farm commercial batch pasteurization of colostrum and serum immunoglobulin concentrations in dairy calves. J. Dairy Sci. 86:1503-1512.

3. Grant, I. R., et al. 2002. Effect of commercial scale high-temperature, short-time pasteurization on the viability of Mycobacterium paratuberculosis in naturally infected cows' milk. Appl. Environ. Microbial. 68:602-607.

4. Jamaluddin, A. A., et al. 1996. Economics of feeding pasteurized colostrum and pasteurized waste milk to dairy calves. JAVMA 209: 751-756.

5. Meylan, M., et al. 1996. Survival of Mycobacterium paratuberculosis and preservation of immunoglobulin G in bovine colostrum under experimental conditions simulating pasteurization. AJVR 57:1580-1585.

6. Stabel, J. R. 2001. On-farm batch pasteurization destroys Mycobacterium paratuberculosis in waste milk. J. Dairy Sci. 84:524-527.

7. Stabel, J. R., et al. 2003. Destruction of Mycobacterium paratuberculosis, *Salmonella sp.*, and *Mycoplasma sp.* in raw milk by a commercial on-farm high-temperature, short-time pasteurizer. J. Dairy Sci. 86(Suppl. 1):247.

from the first run in the morning. During the second run, she turns a valve on the unit so that the pasteurized milk exits at a higher temperature and slowly cools off throughout the day. This milk is stored in an unrefrigerated storage container until being fed that night. Bacteria don't grow at temperatures above 140 degrees F.

Cook's system works – mortality for the last several hundred calves has been 1.3%, with a 1.65-pound-per-day gain for the first eight weeks.

Extra management time may be needed to minimize the pathogen contamination level of the milk or colostrum. Steps include testing cows for Johne's, routinely culturing milk from mastitis cows, milking clean teats, and properly cleaning all milk harvesting and storage equipment. Heavy and moderate shedding Johne's cows and all *Mycoplasma* positive animals should be culled.

Some of the time needed to manage a pasteurizer may come from spending less time treating sick calves. Calves are healthier when fed pasteurized milk than unpasteurized milk. The high fat levels can also help calves to better meet their energy needs during cold weather.

What do you feed calves when there isn't enough waste milk? The easiest approach is to simply dip into the bulk tank. Milk replacers similar in quality to the real thing retail for about $48 a bag, the equivalent of $12.40 milk when mixed at the approximate solids concentration (12.5%) of whole milk.

Another approach is to feed some high protein (~26%) milk replacer with pasteurized milk. Merrell Farms of Wolcott, N.Y., feeds a mixture of approximately 80% milk and 20% milk replacer so that calves are somewhat accustomed to replacer when there isn't enough waste milk.

Financial feasibility

Pasteurizer costs vary depending on the unit type and size. Batch pasteurizers are less expensive than similarly sized HTST units. Additional costs come from needing a tank or containers to store milk, particularly with HTST systems.

The system must be located convenient to calf housing and be equipped with hot water. To do this, you may add costs for a building, storage tanks and transport equipment. (These aren't included in the estimated budget in Table 1.)

Pasteurizer heating expenses are minimal. It costs about a dollar for the electricity to heat a 50-gallon batch of milk. The diesel fuel needed to run the boiler to heat 80 gallons of milk for a HTST unit costs about $2.00 per day. Supplies to properly clean a medium-sized HTST unit run about $1.60 per day.

The time needed to recover pasteurizer purchase and operating expenses was estimated for a variety of dairy sizes (Table 1). Pre- and post-pasteurization holding tanks aren't included in the financial analysis.

The return is quicker for a larger dairy while the cost of the pasteurizer is greater.

Risk evaluation

The presence of pathogens is probably the greatest risk of feeding pasteurized milk. Clinical signs of the calves may immediately alert you to problems with pathogens such as *Salmonella* and *Mycoplasma*. *Map* survival and ability to infect won't be seen clinically for years.

Many pasteurizers come with instruments that continually record milk temperatures. Develop standard operating procedures (SOPs) for animal pathogen testing, milking and milk handling, and the pasteurization procedure. Then make sure that everyone knows them.

Recommendation

Pasteurizing waste milk makes sense for larger dairies. Always take care to minimize the contamination of milk with manure and pathogens. ▮

It's no surprise that producers are pleased with the results of feeding pasteurized waste milk. Whole milk is higher in fat than all milk replacers and higher in protein than most replacers.

Table 1. Estimated time needed to recover pasteurizer purchase cost and associated operating expenses for a variety of dairy sizes[1].

Calves/ Year	Calves on Milk	Annual Milk Replacer Expenses[2]	Pasteurizer Cost, $	Daily Operating Expenses[3]			Approximate time needed to break even
				Pasteurizer Cleaning	Heating	Labor	
50	6	$3,350	5,700 -11,000	$.50 - 2.00	$.10 - .40	$6.00	6 years - Never
100	13	6,700	8,400 -11,000	.75 - 2.30	.25 - .85	8.00	3 – 4 years
200	25	13,400	8,400 -11,000	.75 - 2.30	1.00	10.00	11 - 15 months
500	65	33,500	9,500 -24,300	1.6 - 3.20	1.00 - 2.00	12.00	4 – 10 months
1000	130	67,000	9,800 -24,300	1.6 - 3.20	3.00	12.00	2 – 5 months

[1]Assuming that there is adequate waste milk to feed 6 quarts per calf daily.
[2]Assumed that calves were fed 6 quarts per day of a $48.00 per bag milk replacer mixed to a 12.5% concentration and fed for 6 weeks.
[3]Range in daily expenses is due to the number of times per day the pasteurizer is run, amount of cleaning solutions used and type of heater.